Wind Tunnel and Field Measurements for Aerial ASAE Nozzles

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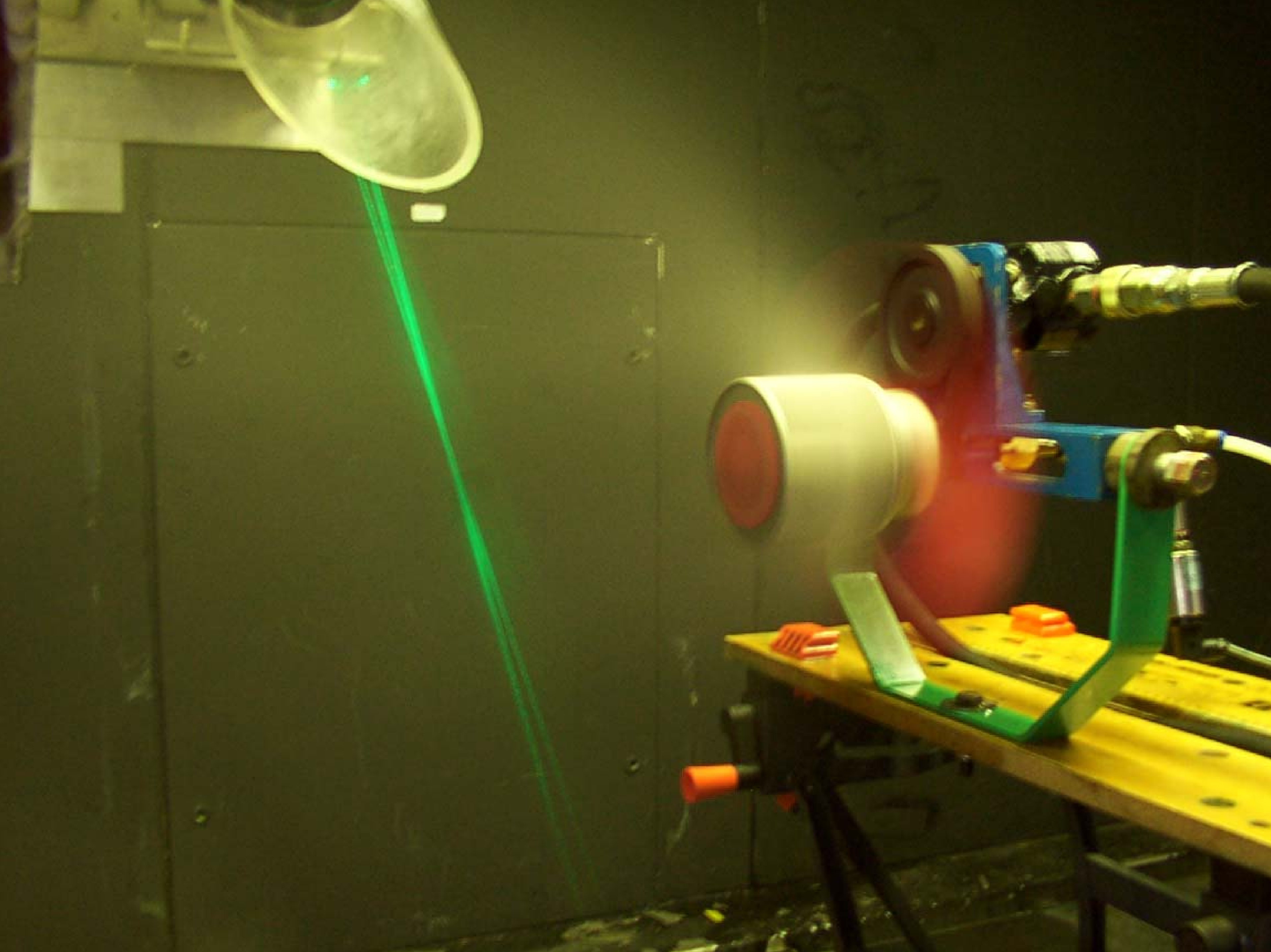
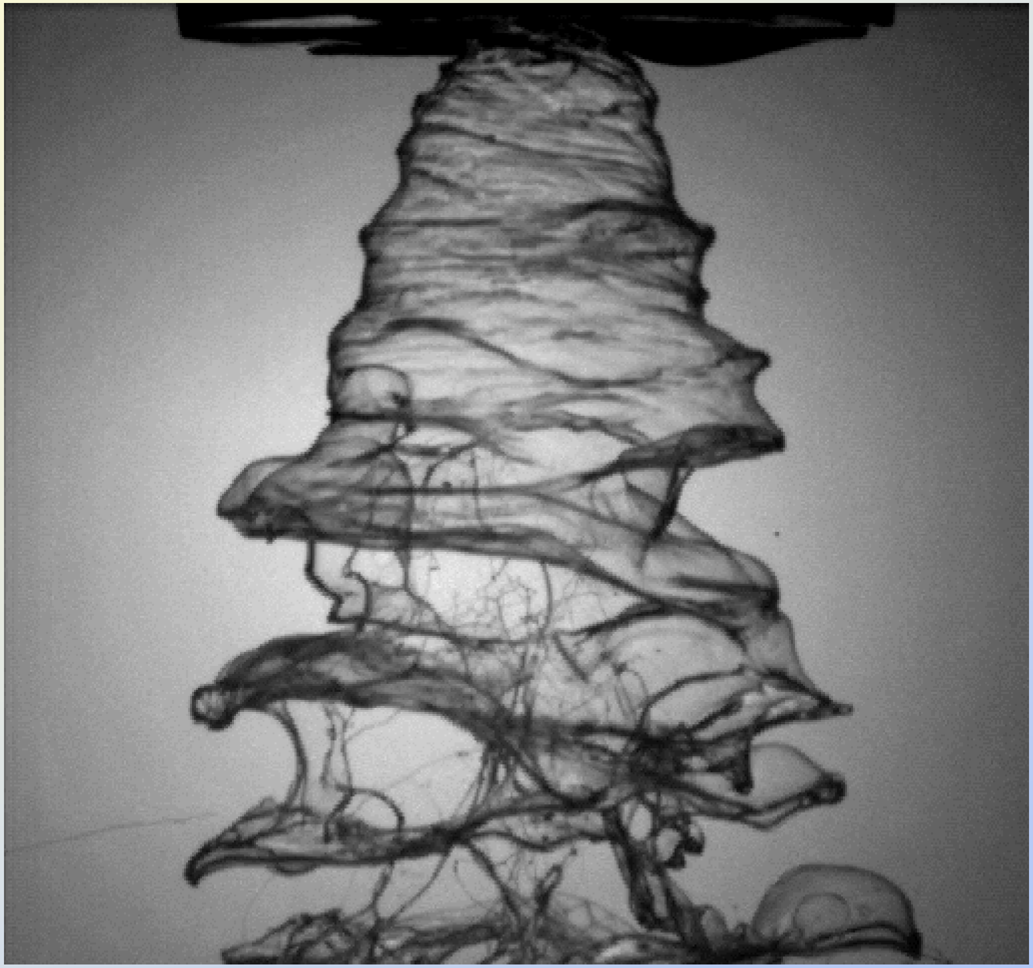
Summary

- Different droplet size analysis systems produce different data – some have ASTM standards for measurement and calibration
- Wind tunnels versus field measurements
- Examples of drift classification for different sprays

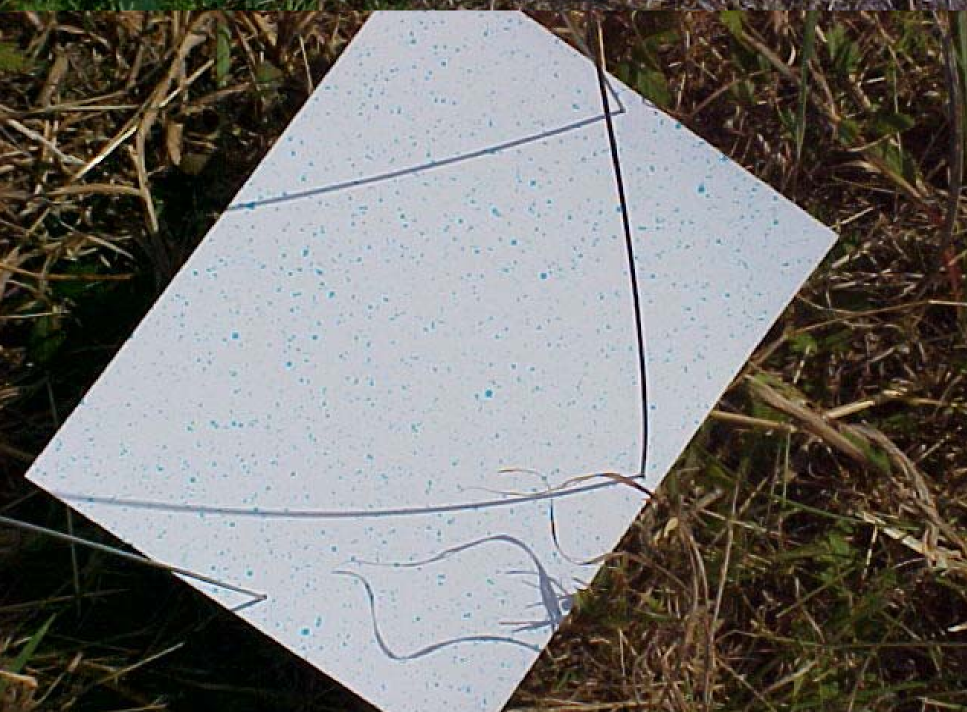
Introduction

- Future pesticide labels will require specific droplet size categories for drift minimization and spray optimization – using ASAE classification system
- Different droplet size analyzers produce different data for the same nozzles and sprays – Malvern, PMS, PDPA, Image Analysis, etc
- Different wind tunnels produce different data
- Wind tunnels differ from field droplet sizing using DropletScan, Swath Kit and other intrusive sampling approaches










Wind Tunnel Versus Field Measurements

- Large field study in Texas with USDA, SDTF, Mosquito Control Industry and others using ASAE reference nozzles, water v oil (evaporation effects), various collectors, two aircraft types, field droplet sizing systems
- Apply same sprays in wind tunnel at same wind speed – ongoing tests with actual test substances
- Develop correlation between field and wind tunnel droplet sizing

Future Field Droplet Sizing

- Labels will specify droplet size required, based on wind tunnel data – before evaporation and in controlled environment (field work - difficult to control meteorological and application conditions)
- Wind tunnel data useful for some tank mixes and nozzles, but impossible to test every actual aircraft setup, boom length effects, multiple tank mixes etc
- Correlation between wind tunnel and field will allow both systems to be used as complimentary to each other to provide maximum information

Example of Modified ASAE Analysis

- Applied Roundup with and without polymer and invert suspension adjuvants in wind tunnel droplet sizing tests
- CP deflector nozzle, 120mph flight speed simulation, laser diffraction particle sizing to resolve down to 4 µm in non-intrusive sampling environment with laminar flow wind tunnel
- NOTE: One polymer selected as an example from hundreds on the market – behavior with different polymers will differ from that observed here.

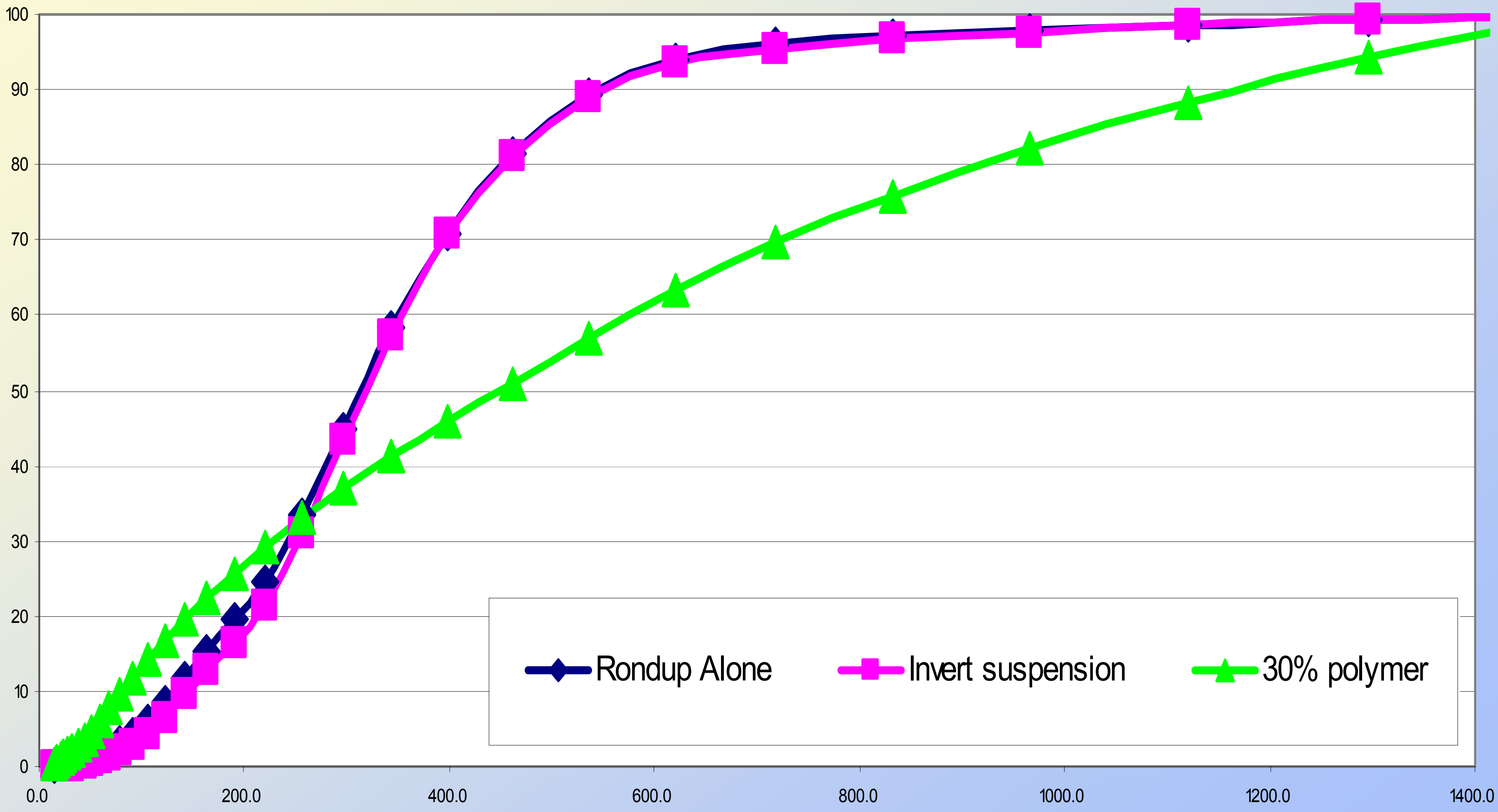
Data Analysis

- Measured droplet size spectra (3 replicates per treatment)
- Ran droplet size spectra through AgDRIFT in aerial application simulation (with regulatory version model defaults) to assess off-target spray movements and deposition including application, meteorological, environmental and evaporation effects
- Analyzed droplet size data with proposed modified ASAE classification approach for drift potential
- This is only an example – behavior with different nozzles, products, and different AgDRIFT input values will differ from behavior seen here

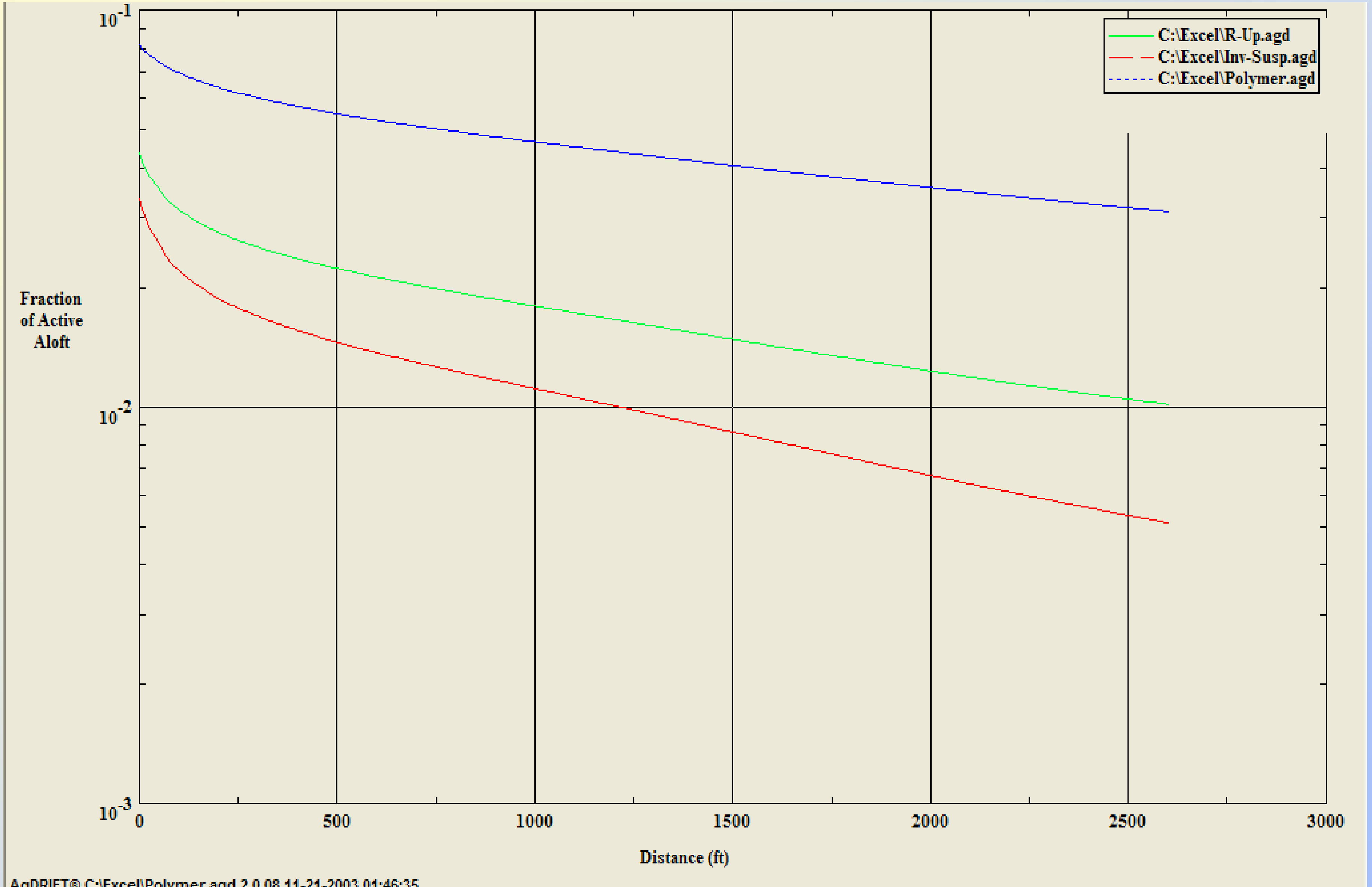
Drift Potential
(from Teske et al NAAA paper 2003)

$$
\begin{aligned}
\text{Drift Potential} = \; & 0.00126534 \\
& + 0.000074433\, D_{V0.1} \\
& - 0.00000337\, D_{V0.5} \\
& - 0.0000186\, D_{V0.9} \\
& + 0.3397122\, F_{141}
\end{aligned}
$$

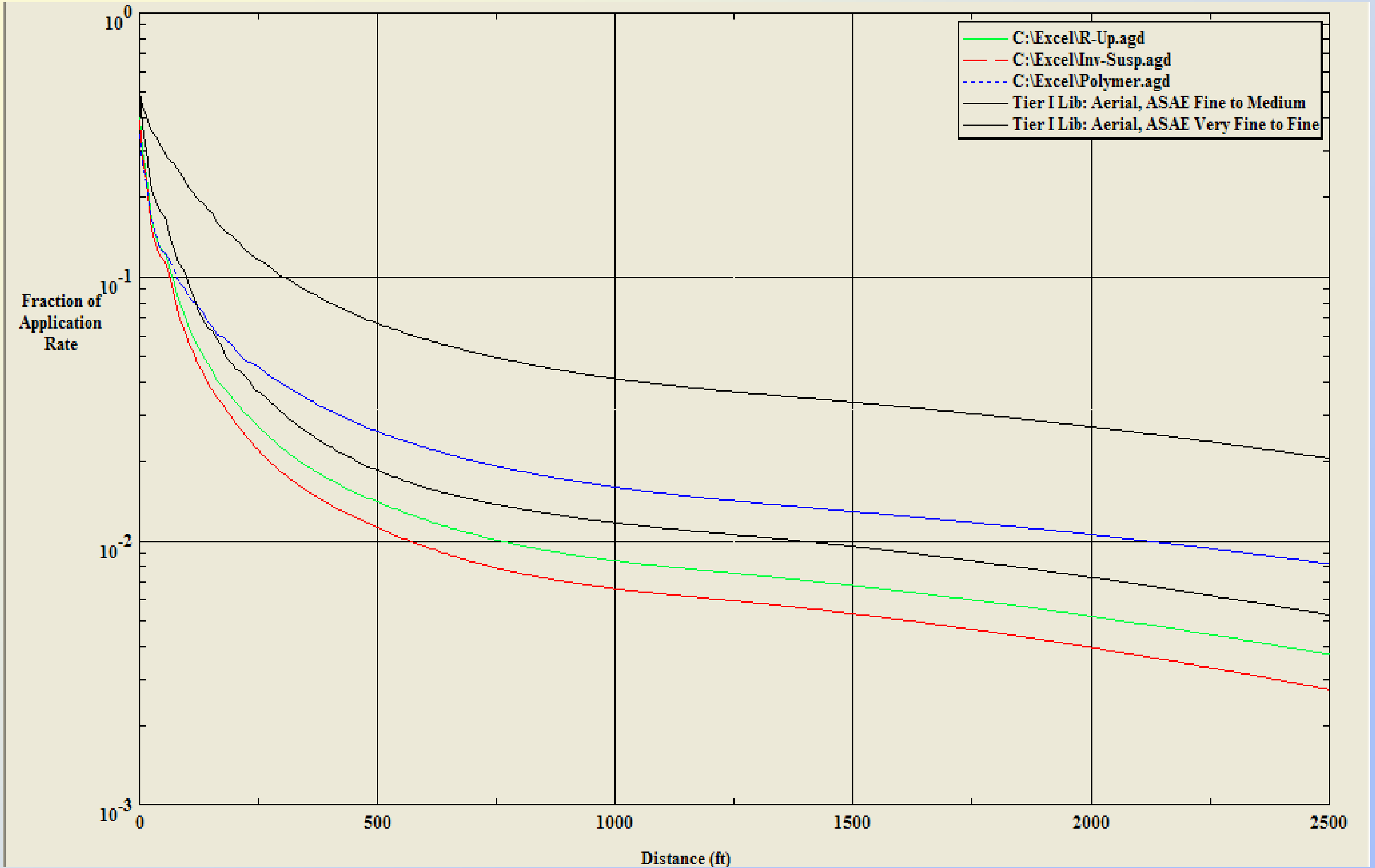
Emission Droplet Size Spectra for Roundup with Different Adjuvants



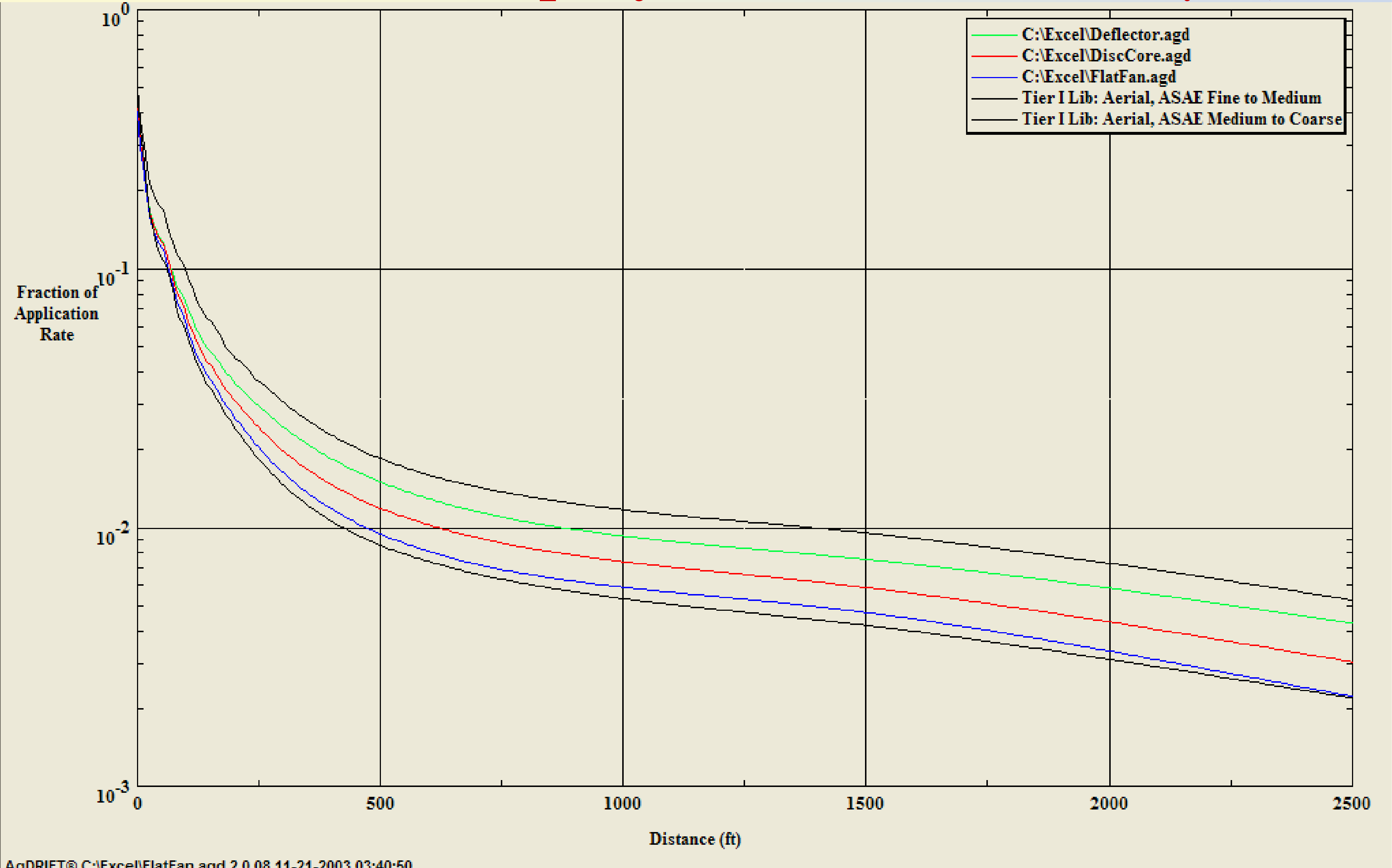
Airborne Drift - AgDRIFT



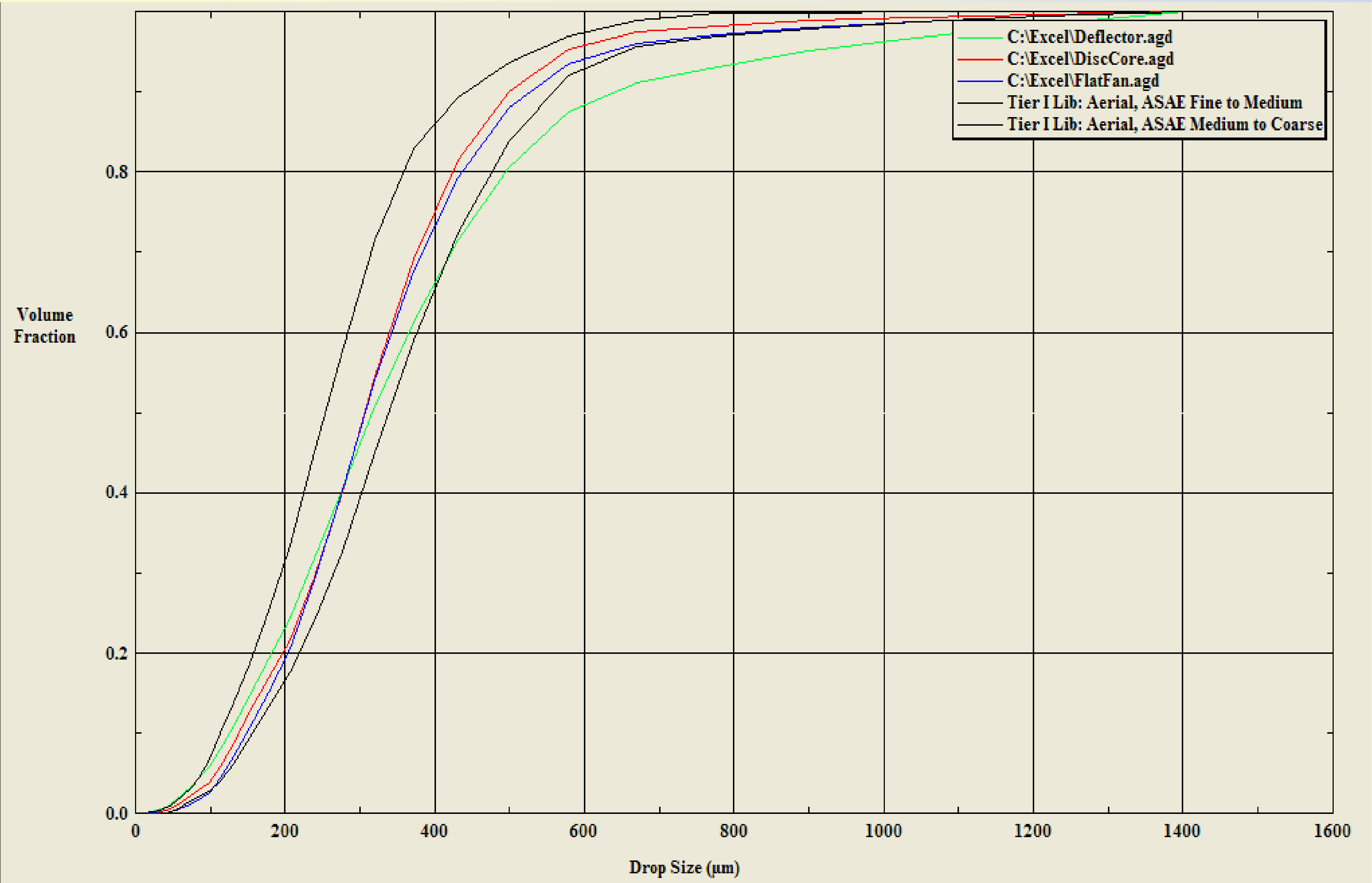
Off-Target Deposition - AgDRIFT



(Similar Effect could be shown for Nozzle Type – All these aerial sprays have VMD of 300 µm)



Same VMD, Different “Fines”



Invert Suspension   Polymer

Numerical Values (Drop Size Distribution: Initial DSD 1)

	Invert Suspension	Polymer
Drop Size Distribution		
$D_{V0.1}$:	144.8 µm	81.7 µm
$D_{V0.5}$:	320.35 µm	450.16 µm
$D_{V0.9}$:	559.53 µm	1178.99 µm
Relative Span:	1.29	2.44
< 141 µm:	9.54 %	19.51 %
Deposition		
Swath Displacement:	22.33 ft	22.33 ft
COV:	0.2512	0.214
Mean Deposition:	0.9638	0.9179
Accountancy of Active		
Application Efficiency:	96.65 %	91.83 %
Downwind Deposition:	2.84 %	5.07 %
Airborne Drift:	0.5103 %	3.11 %
Carrier Evaporated:	13.33 %	19.48 %

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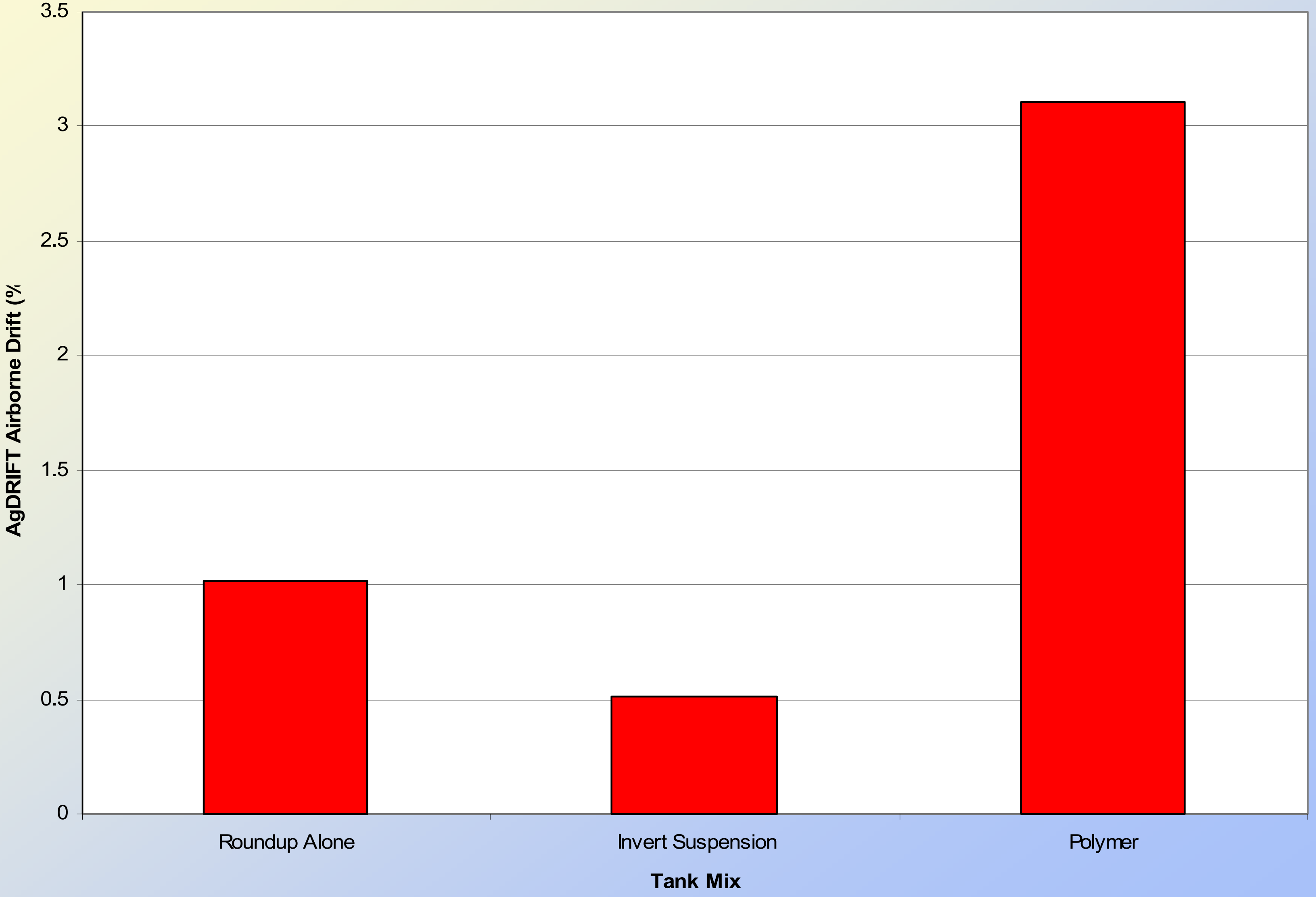
Airborne Drift - AgDRIFT



Drift Potential for Roundup With and Without Adjuvants